NASA Science Mission Directorate

Earth-Sun System Division – Applied Sciences Program

Decision Support through Earth Science Results – Cooperative Agreement Notice
NN-H-04-Z-YO-010-C *(Selection announcements June & September 2005)*

NASA partners with national organizations and Federal agencies to extend NASA Earth science research results into decision support tools to benefit U.S. and global citizens. This solicitation requested projects in two areas: a) projects to integrate NASA Earth science research results (e.g., spacecraft observations, model outputs) into decision-making in twelve areas of national priority (aka, Integrated System Solutions), and b) projects to improve organizational networks of Earth science institutions so public, private, academic, and nonprofit sectors can harness Earth science research results to meet national needs (aka, Solutions Networks).

NASA received 172 Step-2 proposals in response to this 2004/2005 solicitation – 157 Integrated System Solutions and 15 Solutions Networks proposals. NASA originally selected 22 Integrated System Solutions proposals and 1 Solutions Networks proposal for full three-year awards, comprising approximately $22 million over the life of the projects.

After the initial selections, NASA received Congressional direction to augment funding for the Earth-Sun System Division Applied Sciences Program. Using approximately $3 million of this funding, NASA selected 11 additional Integrated System Solutions proposals for one-year awards.

The projects will aid the nation by harnessing Earth science results for improved decision support on national issues, including water management, homeland security, coastal management, agricultural efficiency, public health, and disaster management. The objective for all the projects is to advance the use of NASA Earth science research results to benefit society. The objective for all the projects is to advance the use of NASA Earth science research results to benefit society. The 34 projects provide funding to organizations across 24 different states.

The NASA Applied Sciences Program website has more information about the program: http://science.hq.nasa.gov/earth-sun/applications

The One-year and Three-year projects are listed and described below (in no particular order).

Integration of Earth Science Results with Pest Forecasting and Risk Management Decision

GeorgeMay, Institute for Technology Development – Principal Investigator

Predicting Right Whale Distributions from Space: An Operational System for Marine Ecosystem Modeling

Andrew Pershing, Cornell University – Principal Investigator

Enhancement and Expansion of the Near-Real Time Lake and Reservoir Monitoring System

Charon Birkett, University of Maryland-College Park – Principal Investigator

Flood Inundation Enhancement for NOAA's Advanced Hydrologic Prediction Service

G Robert Brakenridge, Dartmouth College – Principal Investigator

MODIS Products to Improve the Monitoring of Gas Flarings from Offshore Oil and Gas Facilities

Sonia Gallegos, Naval Research Laboratory – Principal Investigator

Improving the RUSLE Model Using Remotely Sensed Crop Residue Maps

Susan White, Institute for Technology Development – Principal Investigator

Impacts of NASA Data and Models on Decision Support Tools in Prince William Sound and Alaska Coastal Oceans

Stephen Okkonen, University of Alaska-Fairbanks – Principal Investigator

Oceanic Convective Weather Diagnosis and Nowcasting

Cathy Kessinger, National Center for Atmospheric Research – Principal Investigator

Use of Satellite Data to Improve the Physical Atmosphere in SIP Decision Making Models

Richard McNider, University of Alabama-Huntsville – Principal Investigator

Integration of a Large-area Invasive Spread Network (LISN) into the NISFS for Ecological Forecasting

Robert Crabtree, Yellowstone Ecological Research Center – Principal Investigator

Integration of NASA Earth Science Data into Pan American Health Organization (PAHO) Health Analysis and Information Decision Support

Carlos Castillo-Salgado, Pan American Health Organization – Principal Investigator

Integration of Decision Support Tools for Managing Carbon Sequestration in the U.S. Forest Sector
Chris Potter, NASA Ames Research Center – Principal Investigator

The US Department of Agriculture/Forest Service (USDA/FS) uses the Carbon OnLine Estimator (COLE) and the Carbon Query and Estimation Tool (CQUEST) to make management decisions, such as timber harvesting. This project validates the incorporation of advanced data products, such as MODIS land cover, Enhanced Vegetation Index, and Fraction of Photosynthetically Active Radiation into the decision support tools. The improved system will help USDA/FS characterize causes of changes in carbon stocks and provide consistency in carbon stock estimation. With such information, the USDA/FS consider carbon management in its forest management decisions. The USDA Forest Service and the California State University-Monterey Bay are collaborators on this project.

Three-Dimensional Air Quality System
Raymond Hoff, University of Maryland at Baltimore County – Principal Investigator

Municipalities and states use information in the US EPA Air Quality System (AQS) and AIRNow forecasting system to assess airborne particulate levels and implement measures to meet the ambient air quality standards. This project incorporates a range of remote sensing data (AIRS, MODIS, OMI, GOES, CALIPSO, and others) to expand AQS into a three-dimensional system, which also supports the Centers for Disease Control's (CDC) environmental public health tracking network and NOAA's air quality mapping system. The CDC, US EPA, NOAA, Batelle Memorial Institute, University of Wisconsin-Madison, and others are collaborators on this project.

Enhancing the Famine Early Warning System Network Decision Support System with NASA Earth System Science Data and Modeling Results
Molly Elizabeth Brown, NASA Goddard Space Flight Center – Principal Investigator

The U.S. Agency for International Development (USAID) employs the Famine Early Warning System Network (FEWS NET) to direct humanitarian assistance in a timely manner when famines occur or threaten. This project incorporates MODIS-AVHRR NDVI, TRMM-GPCP-CMAP, and Landsat ETM+ into FEWS NET to improve the advance warning of famine conditions. With such information, USAID and local agencies in affected areas can be better prepared to provide on-the-ground monitoring and responses such as food aid, seeds, and tools. The USAID, Science Systems and Applications Inc. (SSAI), NOAA, USGS, and the University of California-Santa Barbara are collaborators on this project.

Global Fire Information for Resource Management: Transitioning from a Research to an Operational System with an Emphasis on Protected Areas
Diane Davies, University of Maryland at College Park – Principal Investigator

Protected area managers use the Fire Information for Resource Management System (FIRMS) to make resource management decisions to mitigate and respond to wildfires. FIRMS is a Web-based geographic information system with interactive maps that issues email and text-message alerts. This project incorporates MODIS burned area products into FIRMS, enabling improved strategic fire management, more informed fire policy, and improved allocation of limited resources. The United Nations Food and Agriculture Organization, Conservation International, and others are collaborators on this project.

Integrating MODIS and VIIRS NPP Observations into the USDA FAS Decision System
Christopher Justice, University of Maryland at College Park – Principal Investigator

The USDA's Foreign Agricultural Service (FAS) employs a global crop production system in its analyses and forecasts of the condition of major agricultural commodities worldwide. The FAS forecasts are the primary input into the global production and yield forecasts published by the World Agricultural Outlook Board. This project incorporates MODIS and VIIRS data into the FAS CADRE system (Crop condition, Data Retrieval and Evaluation) and the FAS Crop Explorer to support the FAS analyses, including early warning of unusual crop conditions and production anomalies. The USDA FAS is a collaborator on this project.

Enhancements to the BlueSkyRAINS Emissions Assessment and Air Quality Prediction System
Dana Sullivan, Sonoma Technology, Inc. – Principal Investigator

Smoke and fire managers use the BlueSkyRAINS tool to make daily decisions about prescribed burns, and air quality agencies use the tool to support policy decisions and public notification about emissions transport, regional haze, and state implementation plans. The project automates the integration of NASA MODIS products and other Earth science products to improve the timeliness and accuracy of BlueSkyRAINS, enhance predictions of emissions and air quality impacts from fires, and expand its use nationwide. The US Forest Service, Western Regional Air Partnership, Central Regional Air Planning Association, US Environmental Protection Agency (EPA), NOAA, and others are collaborators on this project.

Decision Support for Aircraft Avoidance of Convectively-Induced Turbulence due to Thunderstorms
Robert Sharman, National Center for Atmospheric Research – Principal Investigator

Airline meteorologists, dispatchers, and pilots us the Graphical Turbulence Guidance (GTG) forecasting system to make decisions regarding route planning and flight routing

in order to avoid turbulence. This project incorporates MODIS gravity wave data, GOES imagery, and Lightning Mapping Array data into GTG to enhance the ability to model Convectively-Induced Turbulence (CIT), which poses a significant risk to air travel. The University of Wisconsin-Madison and University of Alabama-Huntsville are collaborators on this project, and the principal investigator leads the Federal Aviation Administration (FAA) Aviation Weather Research Program Turbulence Product Development Team.

Improved Meteorological Input for Atmospheric Release Decision Support Systems
Thomas Warner, National Center for Atmospheric Research – Principal Investigator

Emergency management organizations use the Department of Energy's National Atmospheric Release Advisory Center (NARAC) and the Department of Defense's Hazard Prediction and Assessment Capability (HPAC) to plan and respond to atmospheric releases of hazardous materials (terrorist or accidental). Emergency managers use contaminant information from atmospheric, transport, and diffusion models to plan evacuation routes, avoid contamination of first-responders, contain the hazardous materials, and during post-event decontamination. This project incorporates QuikSCAT data, Weather Research and Forecast (WRF) products, AMSR-E, MODIS, NOAH Land Surface Model products, and other products into NARAC and HPAC to improve the calculation of contaminant concentrations and dosage. Lawrence Livermore National Laboratory is a collaborator on this project.

Satellite-Based Prediction of Clear Air Turbulence Associated with Tropopause Folds and Unbalanced Upper-Level Fronts
Steven Koch, NOAA – Principal Investigator

The aviation industry uses the Graphical Turbulence Guidance (GTG) system to model clear air turbulence to support route planning and flight routing. GTG employs turbulence predictor fields computed from the Rapid Update Cycle (RUC) numerical weather prediction model. This project uses OMI ozone data, GOES True Water Vapor (TWV), MODIS ozone and water vapor imagery, and GOES Ozone soundings to locate actively developing tropopause folds and unbalanced upper-level fronts, which are associated with turbulence. If successful, the project techniques become part of GTG and will result in improved aviation safety and fewer delays. The University of Wisconsin-Madison and NOAA are collaborators on this project.

Use of NASA Remote Sensing Datasets in NOAA National Weather Service River Forecast Centers' Hydrologic Modeling
Ashutosh Limaye, Universities Space Research Association – Principal Investigator

The National Weather Service uses the River Forecast System to issue river and flood forecasts and warnings and to provide hydrology forecast information for economic and environmental purposes. Hydrologic observations and operational streamflow forecasts are carried out on a continuous basis for approximately 4,000 river locations. This project incorporates MODIS Cloud Mask data and MODIS Land Surface Temperature

data into the River Forecast System to improve streamflow and flood estimation, leading to improved decisions regarding flood warnings. The NOAA National Weather Service, Global Hydrology & Climate Center, and others are collaborators on this project.

Enhancement of the U.S. Drought Monitor by Integrating NASA Earth Science Data
James Verdin, USGS EROS Data Center – Principal Investigator

Federal, state, industry, and other organizations use the U.S. Drought Monitor (USDM) to inform decisions on drought planning, risk management, drought designation, and mitigation. The USDM is a weekly, operational map-based product that portrays current broad scale drought conditions, such as intensity, extent, and resultant impacts. This project uses MODIS NDVI data to create a Vegetation Drought Response Index (VegDRI), which is then integrated into USDM. The National Drought Mitigation Center, University of Nebraska-Lincoln, USGS, and Augustana College are collaborators on this project.

Near Real-time NASA Volcanic Cloud Data for NOAA, FAA, and USGS Decision Support Systems
Arlin Krueger, University of Maryland at Baltimore County – Principal Investigator

Volcanic ash poses a substantial risk to aviation. The NOAA Forecast Systems Laboratory and the FAA Oceanic Weather Product Development Team use the Volcanic Ash Coordination Tool (VACT) to improve volcanic cloud detection and eruption warnings. This project incorporates Aqua AIRS SO_2 and ash data and OMI SO_2 and ozone data into VACT. FAA, airlines, and the military use VACT information to improve advisory/warning decisions, and USGS uses the data to better diagnose eruption potential and warnings. NOAA, USGS, the Royal Netherlands Meteorological Institute, and others are collaborators on this project.

Integrating Earth Science Enterprise Results into Protected Area Decision Support for the Albertine Rift
Nadine Laporte, Woods Hole Research Center – Principal Investigator

Resource managers in Central Africa use the Integrated Forest Monitoring System (INFORMS) to protect ecosystems, conserve and manage forests, and reduce deforestation and habitat loss. This project uses the INFORMS approach and incorporates ASTER, MODIS, and SRTM products and *in situ* climatic data into three decision support tools used in the Albertine Rift area to manage forests and reduce illegal activities, such as poaching. The project will also employ niche-based modeling approaches to forecast potential species distributions. The Wildlife Conservation Society, Worldwide Fund for Nature, USAID, UNESCO, and forest and wildlife authorities of Uganda, Rwanda, and the Democratic Republic of the Congo are collaborators on this project.

National Drought Monitoring System for Drought Early Warning Using Hydrologic and Ecologic Observations from NASA Satellite Data
Son Nghiem, JPL – Principal Investigator

A wide variety uses, including farmers, ranchers, industries, and Federal and state agencies use forecasts from the US Drought Monitor and use drought monitoring and drought early warning in their decision making. This project incorporates AMSR-E soil moisture, QSCAT precipitation water on land surface, and MODIS vegetation state products to enhance the indices used in USDM and improve the drought and water supply forecasts. NOAA, Dartmouth College, and the University of Nebraska-Lincoln are collaborators on this project.

A Water Cycle Solutions Network
Paul Houser, George Mason University – Principal Investigator
Formerly with NASA-Goddard Space Flight Center

Federal agencies employ knowledge and research about the water cycle in their decision support tools to aid in management and policy activities. This project develops a solutions network initialized by NASA Water Cycle research results. The project systematically engages existing water cycle research partners and community organizations to identify, prioritize, mine, and communicate relevant NASA water cycle results. This Water Cycle Solutions Network makes available connections to research results for development into integrated system solutions that ultimately can assist and improve the decision support processes on a national scale. NOAA, George Mason University, University of California-Irvine, and others are collaborators on this project.

Integrate NASA's Global Soil Moisture Remote Sensing and Modeling Data into USDA's Crop Production Decision Support System
Xiwu Zhan, University of Maryland at Baltimore County – Principal Investigator

The USDA Foreign Agricultural Service (FAS) employs a global crop production system in its analyses and forecasts of the condition of major agricultural commodities worldwide. These forecasts define the fundamental conditions of commodity markets, affecting decisions by farmers, businesses, and government agencies. This project incorporates the AMSR-E soil moisture product into the FAS CADRE system (Crop condition, Data Retrieval and Evaluation) to improve soil moisture and precipitation estimates, leading to improved forecasting of crop yields. The USDA FAS, University of Melbourne, and others are collaborators on this project.

Improving NOAA/NWS River Forecast Center Decision Support with NASA Satellite and Land Information System Products
Pedro Restrepo, NOAA – Principal Investigator

The National Weather Service uses the River Forecast System to issue river and flood forecasts and warnings and to provide hydrology forecast information for economic and

environmental purposes. The project incorporates AMSR-E, TRMM, and MODIS LAI, EVI, and NDVI information on soil moisture, surface temperature, and snow cover to improve accuracy in runoff, flow, and snow state monitoring and prediction. SAIC and others are collaborators on this project.

Using the Invasive Species Forecasting System to Support National Park Service Decisions on Fire Management Activities and Invasive Plant Species Control
Jeffrey Morisette, NASA Goddard Space Flight Center – Principal Investigator

Fire and invasive species are two major interrelated sources of ecological disturbance. The National Park Service (NPS) uses the USGS Invasive Species Forecasting System (ISFS) to relate invasive species and fires to manage park lands and guard against alien plant invasions. This project incorporates MODIS active fire, MODIS burnt area products, and ASTER/EO-1 burnt severity mapping, and invasive special modeling into the USGS Invasive Species Forecasting System (ISFS) to improve the NPS fire management and invasive species management plans. The NPS, USGS, National Interagency Fire Center, and other are collaborators on this project.

Improving Water Resources Management in the Western U.S. through Use of Remote Sensing Data and Seasonal Climate Forecasts
Dennis Lettenmaier, University of Washington at Seattle – Principal Investigator

Water resource management is one of the most critical environmental issues of the 21st century, and it is a particularly important topic in the Western U.S. The Bureau of Reclamation, the USDA Natural Resources Conservation Service, and western state agencies use forecasts from the University of Washington's west-wide hydrologic forecast system in their decisions. This project incorporates MODIS snow cover extent, evapotranspiration, and reservoir surface temperature products, AMSR-E snow water equivalent products, and GMAO climate forecasts into the UW hydrologic forecast system to improved predictions of snowmelt runoff for reservoir and other water management decisions. The University of California-Irvine is a collaborator on this project.

Integrating NASA Earth Science Results into Malaria Early Warning Products to Enhance USAID Food Security and Disaster Management Decision Making
James Verdin, USGS EROS Data Center – Principal Investigator

Precipitation, temperature, and other environmental variables are highly correlated with malaria transmission rates. This project incorporates precipitation estimates from TRMM and Aqua AMSR, elevation data from SRTM, Landsat cover maps, and temperature and precipitation fields from MM5 and fvGCM into USAID FEWS NET and WHO HealthMapper to improve malaria control decision support for USAID, international organizations, and non-governmental organizations. Columbia University, USAID, WHO, and others are collaborators on this project.

An Integrated LES Modeling System for Atmospheric Dispersion of Toxic Agents: Homeland Security Applications
Udaysankar Nair, University of Alabama at Huntsville – Principal Investigator

Large Eddy Simulation (LES) models atmospheric dispersion of toxic agent release, such as might occur as the result of terrorist action. This project incorporates MODIS and ASTER land characteristic data, MM5/WRF model, and HYSPLIT dispersions into the Regional Atmospheric Modeling System in LES mode to support the Information Fusion Cell (IFC) and Force Protection Operational Requirements Testbed (FORT) decision support tools employed by the Army Missile Research Development and Engineering Center.

Improvement of Operational Aircraft Icing Forecasts and Diagnoses by Assimilation of Satellite Cloud/Surface Properties in the RUC/WRF
Patrick Minnis, NASA Langley Research Center – Principal Investigator

The FAA Aviation Weather Program and the aviation community use the NOAA Rapid Update Cycle (RUC) for diagnosing and forecasting aircraft icing conditions. This project incorporates MODIS and GOES estimate of liquid water path (LWP) and cloud products into the RUC analysis to improve diagnoses and forecasts of icing conditions and potential impacts on general weather forecasts and other transportation methods. Benefits potentially include more accurate analyses and forecasts of clouds, locations of potential aircraft icing, and severity of icing conditions. NOAA is a collaborator on this project.

Decision Support for Loblolly Pine Carbon Management: From Research to Operations
Randolph Wynne, Virginia Polytechnic and State University – Principal Investigator

Understanding carbon fluxes of woody biomass is critical to understanding the carbon sequestration potential of forests. The LobDST and CQUEST tools inform forest management practices for loblolly pine. This project incorporates Aqua, Terra, and ASTER products into these tools to allow landowners to manage their lands for carbon sequestration. Benefits will include increased rate of carbon sequestration and decreased cost of carbon management. The California State University-Monterey Bay, the National Council of the Paper Industry for Air and Stream Improvement (NCASI), and others are collaborators on this project.